

## **AD7416/AD7417/AD7418**

### **FEATURES**

- 10-bit ADC with 20 $\mu$ s Conversion Time
- I<sup>2</sup>C interface
- On-Chip Temperature Sensor  
-55°C to +125°C
- On-Chip Reference (2.5V $\pm$ 1%)
- 2.7V to 5.5V Power Supply
- 3.5 $\mu$ W Power Consumption at 10spS
- Automatic Power Down After Conversion
- Over Temperature Interrupt Pin
- 8-pin microSOIC package (AD7416/AD7418)
- 10-pin microSOIC package (AD7417)

### **APPLICATIONS**

- Ambient Temperature Monitoring
- Data Acquisition Systems With Ambient Temperature Monitoring
- Digital Demodulation

### **GENERAL DESCRIPTION**

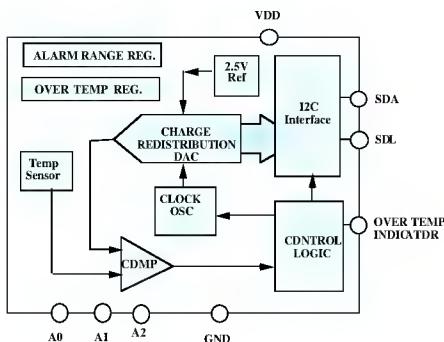
The AD 7416/AD 7417/AD 7418 are analog to digital converters with an on-chip temperature sensor and 2.5V reference. The AD 7816 address can be selected using A0, A1 and A2. These pins set the 3 LSBs of the device address. The AD 7818 allows an external reference to be applied and allows access to the ADC function, Ain input pin, which can accept signals from 0V to Vref. The AD 7817 has a four channel Ain multiplexer. An over temperature interrupt pin and on-chip digital register allows the user to

program a set point. This can be used to provide an alarm function when the temperature exceeds the selected value. The value in the alarm range register selects the value, below which, the interrupt will become inactive. The I<sup>2</sup>C interface makes these parts ideal for a wide range of applications including thermal management in personal computers. The AD 7417 and AD 7418 has a CONVST pin which allows the user to determine the sampling instance of the previously selected analog input channel or temperature sensor. If the CONVST function is not required, it should be connected low, in which case a conversion is initiated directly after a change occurs in the multiplexer selected, or every 355 $\mu$ s, whichever occurs first. The conversion result can be read from at any time.

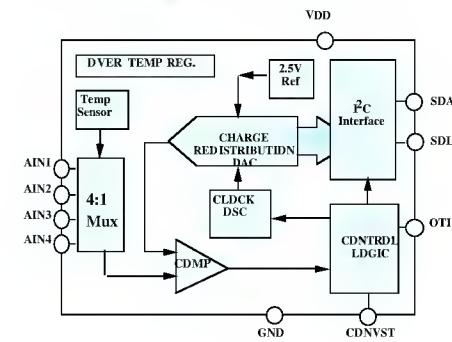
### **PRODUCT HIGHLIGHTS**

1. These devices have On-Chip Temperature Sensors which allows an accurate measurement of the ambient temperature ( $\pm 1^\circ\text{C}$  @  $25^\circ\text{C}$ ,  $\pm 2^\circ\text{C}$  over temperature) to be made. An over temperature interrupt is implemented by carrying out a digital comparison of the ADC code with the contents of the On-Chip Over Temperature Register.
2. The automatic power down features enables the user to perfectly tune the power to achieve the lowest possible power consumption at their selected throughput rate.
3. The 8-pin microSOIC package, which is roughly 50% of the size of an 8-pin SOIC, minimises board space.

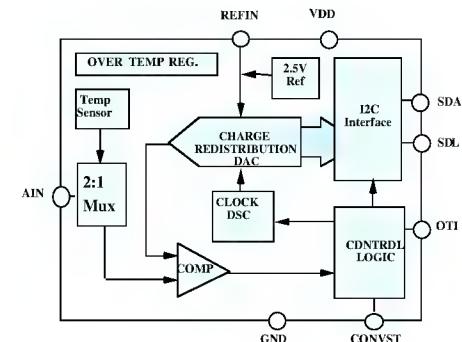
### **FUNCTIONAL BLOCK DIAGRAM**



AD7416



AD7417



AD7418

Rev A.1

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# AD7416/AD7817/AD7418

## AD7416/AD7417/AD7418- SPECIFICATIONS<sup>1</sup> ( $V_{DD} = +2.7V$ to $+5.5V$ , GND = 0 V, $REF_{IN} = +2.5$ V.)

| Parameter   | A Version<br>-40°C to<br>+85°C | A Version<br>-55°C to<br>+125°C | B Version<br>-40°C to<br>+85°C | Units            | Test Conditions/Comments                     |
|---|--------------------------------|---------------------------------|--------------------------------|------------------|--|
| DYNAMIC PERFORMANCE   |                                |                                 |                                |                  |  |
| Signal to (Noise+Distortion) Ratio <sup>2</sup>               | 58                             | 58                              | 58                             | dB min           | Sample Rate = 100kSPS, Any Channel           |
| Total Harmonic Distortion <sup>2</sup>                        | -66                            | -66                             | -66                            | dB max           | $f_{IN} = 20\text{ kHz}$                     |
| Peak Harmonic or Spurious Noise <sup>2</sup>                  | -66                            | -66                             | -66                            | dB typ           |  |
| Intermodulation Distortion <sup>2</sup>                       |                                |                                 |                                |                  | $f_a = 48\text{ kHz}, f_b = 48.5\text{ kHz}$ |
| 2nd Order Terms   | -67                            | -67                             | -67                            | dB typ           |  |
| 3rd Order Terms   | -67                            | -67                             | -67                            | dB typ           |  |
| Channel-to-Channel Isolation <sup>2</sup>                     | -80                            | -80                             | -80                            | dB typ           | $f_{IN} = 20\text{ kHz}$                     |
| DC ACCURACY   |                                |                                 |                                |                  | Any Channel                                  |
| Resolution  | 10                             | 10                              | 10                             | Bits             |  |
| Minimum Resolution for Which Non Missing Codes are Guaranteed | 10                             | 10                              | 10                             | Bits             |  |
| Relative Accuracy <sup>2</sup>                                | ±1                             | ±1                              | ±1                             | LSB max          |  |
| Differential Nonlinearity <sup>2</sup>                        | ±1                             | ±1                              | ±1                             | LSB max          |  |
| Gain Error <sup>2</sup>                                       | ±2                             | ±2                              | ±2                             | LSB max          |  |
| Gain Error Match <sup>2</sup>                                 | ±1/2                           | ±1/2                            | ±1/2                           | LSB max          |  |
| Offset Error <sup>2</sup>                                     | ±2                             | ±2                              | ±2                             | LSB max          |  |
| Offset Error Match  | ±1/2                           | ±1/2                            | ±1/2                           | LSB max          |  |
| ANALOG INPUTS   |                                |                                 |                                |                  |  |
| Input Voltage Range   | $V_{REF}$<br>0                 | $V_{REF}$<br>0                  | $V_{REF}$<br>0                 | V max            |  |
| Input Leakage Current   | ±1                             | ±1                              | ±1                             | V min            |  |
| Input Capacitance   | 10                             | 10                              | 10                             | µA max           |  |
| External Reference $V_{REF}$ = 2.5V                           |                                |                                 |                                | pF max           |  |
| TEMPERATURE SENSOR <sup>1</sup>                               |                                |                                 |                                |                  |  |
| Operating Range   | +85<br>-40                     | +125<br>-55                     | +85<br>-40                     | °C max<br>°C min |  |
| Measurement Error   |                                |                                 |                                |                  |  |
| Ambient Temperature 25°C                                      | ±2                             | ±2                              | ±1                             | °C max           |  |
| $T_{MIN}$ to $T_{MAX}$  | ±3                             | ±3                              | ±2                             | °C max           |  |
| Measurement Error   |                                |                                 |                                |                  |  |
| Ambient Temperature 25°C                                      | ±2                             | ±2                              | ±1                             | °C typ           |  |
| $T_{MIN}$ to $T_{MAX}$  | ±3                             | ±3                              | ±2                             | °C typ           |  |
| Temperature Resolution  | 1/4                            | 1/4                             | 1/4                            | °C/LSB typ       |  |
| On-chip Reference   |                                |                                 |                                |                  |  |
| REFERENCE INPUT <sup>3,4</sup>                                |                                |                                 |                                |                  |  |
| REF <sub>IN</sub> Input Voltage Range <sup>4</sup>            | 2.625<br>2.375                 | 2.625<br>2.375                  | 2.625<br>2.375                 | V max<br>V min   | 2.5 V + 5%                                   |
| Input Impedance   | 50                             | 50                              | 50                             | kΩ min           | 2.5V - 5%                                    |
| Input Capacitance   | 10                             | 10                              | 10                             | pF max           |  |
| ON-CHIP REFERENCE   |                                |                                 |                                |                  | Nominal 2.5V                                 |
| Reference Error <sup>3</sup>                                  | ±25                            | ±25                             | ±25                            | mV max           |  |
| Temperature Coefficient <sup>3</sup>                          | 50                             | 50                              | 50                             | ppm/°C typ       |  |

| Parameter                          | A Version<br>-40°C to<br>+85°C | A Version<br>-55°C to<br>+125°C | B Version<br>-40°C to<br>+85°C | Units          | Test Conditions/Comments                  |
|------------------------------------|--------------------------------|---------------------------------|--------------------------------|----------------|---|
| <b>LOGIC INPUTS<sup>5</sup></b>    |                                |                                 |                                |                |   |
| Input High Voltage, $V_{INH}$      | 2.4                            | 2.4                             | 2.4                            | V min          | $V_{DD} = 5V \pm 10\%$                    |
| Input Low Voltage, $V_{INL}$       | 0.8                            | 0.8                             | 0.8                            | V max          | $V_{DD} = 5V \pm 10\%$                    |
| Input High Voltage, $V_{INH}$      | 2                              | 2                               | 2                              | V min          | $V_{DD} = 3V \pm 10\%$                    |
| Input Low Voltage, $V_{INL}$       | 0.4                            | 0.4                             | 0.4                            | V max          | $V_{DD} = 3V \pm 10\%$                    |
| Input Current, $I_{IN}$            | $\pm 3$                        | $\pm 3$                         | $\pm 3$                        | $\mu A$ max    | Typically 10nA, $V_{IN} = 0V$ to $V_{DD}$ |
| Input Capacitance, $C_{IN}$        | 10                             | 10                              | 10                             | pF max         |   |
| <b>LOGIC OUTPUTS<sup>5</sup></b>   |                                |                                 |                                |                |   |
| Output High Voltage, $V_{OH}$      | 4                              | 4                               | 4                              | V min          | $I_{SOURCE} = 200 \mu A$                  |
|                                    | 2.4                            | 2.4                             | 2.4                            | V min          | $V_{DD} = 5V \pm 10\%$                    |
| Output Low Voltage, $V_{OL}$       | 0.4                            | 0.4                             | 0.4                            | V max          | $V_{DD} = 3V \pm 10\%$                    |
|                                    | 0.2                            | 0.2                             | 0.2                            | V min          | $I_{SINK} = 200 \mu A$                    |
| High-Impedance Leakage Current     | $\pm 10$                       | $\pm 10$                        | $\pm 10$                       | $\mu A$ max    | $V_{DD} = 5V \pm 10\%$                    |
| High-Impedance Capacitance         | 15                             | 15                              | 15                             | pF max         | $V_{DD} = 3V \pm 10\%$                    |
| <b>CONVERSION RATE<sup>5</sup></b> |                                |                                 |                                |                |   |
| Track/Hold Acquisition Time        | 400                            | 400                             | 400                            | ns max         | Source Impedance < 10Ω                    |
| Conversion Time                    |                                |                                 |                                |                |   |
| Temperature Sensor                 | 20                             | 20                              | 20                             | $\mu s$ max    |   |
| Channels 1 to 4                    | 20                             | 20                              | 20                             | $\mu s$ max    |   |
| <b>POWER REQUIREMENTS</b>          |                                |                                 |                                |                |   |
| $V_{DD}$                           | +5.5<br>+2.7                   | +5.5<br>+2.7                    | +5.5<br>+2.7                   | V max<br>V min | For Specified Performance                 |
| $I_{DD}$                           |                                |                                 |                                |                |   |
| Normal Operation                   | 1.0                            | 1.0                             | 1.0                            | mA typ         | Logic Inputs = 0V or $V_{DD}$             |
| Using External Reference           |                                |                                 |                                | mA max         | 2.5V external reference connected         |
| Power Down                         | 1.0                            | 1.0                             | 1.0                            | $\mu A$ max    | 500nA typically                           |
| NOTES <sup>1</sup>                 |                                |                                 |                                |                |   |